



# Teflon® AF

amorphous fluoropolymers

## Safety in Handling and Use

### Introduction

This technical information provides guidelines for the safe handling and use of *Teflon*® AF amorphous fluoropolymer resins. Temperatures, ventilation, scrap disposal, soldering, and machining are considered.

### Pyrolysis Studies

#### **Weight Loss vs. Temperature**

*Teflon*® AF resins are thermally stable up to about 360°C (680°F) in air. Using sensitive analytical techniques, the isothermal rate of weight loss of *Teflon*® AF in air at 360°C (680°F) has been shown to be 0.2 to 0.6%/hr. Compared with other polymers, the weight loss rates for *Teflon*® AF resins are extremely low and similar to rates for *Teflon*® FEP.

#### **Decomposition Products**

When *Teflon*® AF resins are decomposed in air at temperatures from 360 to 450°C (680 to 842°F), products observed are HF from reaction of COF<sub>2</sub> with moist air, COF<sub>2</sub>, CO, and hexafluoroacetone (HFA). The amount of HFA evolved upon complete decomposition at 500°C (932°F) is up to 100–200 mg/g of sample.

The OSHA permissible exposure limit for HF is 3 ppm, and for HFA is 0.1 ppm. In animal tests, HFA has been shown to be a potent reproductive and developmental toxin. To protect against reproductive or developmental hazards from HFA fumes, DuPont recommends an exposure limit of 0.1 ppm for men and women not of childbearing capability, and 0.005 ppm for women of childbearing capability. A skin notation, denoting that measures should be taken to protect against significant skin absorption, applies for HFA hydrates.

### Handling Practices

*Teflon*® AF resins contain parts per million of residual HFA. Because HFA hydrates are readily absorbed through the skin, it is necessary to avoid

skin contact with the resin during processing.

DuPont recommends the use of protective gloves if handling of the resin is required during manufacturing operations.

Some residual gases (including HF, COF<sub>2</sub>, CO, and HFA), which may be harmful, diffuse from *Teflon*® AF resins even at room temperature. Therefore, to avoid exposure, all resin containers should be opened and used only in well-ventilated areas using local exhaust ventilation (LEV).

In addition, it is recommended that exhaust hoods be installed to remove *all* of the off-gases released from hot polymers in work areas. For this purpose, a number of hood designs are shown in **Figure 1**. These designs present several alternatives to allow adequate exhaust volumes for effective capture and removal of all of the off-gases.

The types of situations normally encountered and the capture velocities needed to remove all the gases from the local vicinity of the hot polymer are summarized in **Table 1**.

The type of work situation is selected from **Table 1**, and the centerline velocity required to capture all of the gases is then used to calculate the volumetric rate of air flow (in m<sup>3</sup>/s/cfm) required for the hood selected from **Figure 1**. For example, in the extrusion coating of wire, a capture velocity of 1 m/s (200 fpm) may be needed. A hood of the plain-opening design with an area of its face of 0.05 m<sup>2</sup> (0.5 sq ft) is placed 0.15 m (0.5 ft) above the discharge face of the extruder. To remove all the gases generated at the face of this hood, an air volume of 600 cfm (0.28 m<sup>3</sup>/s) is needed, as calculated below (note that all dimensions must be expressed in meters or feet):

$$Q = V (10X^2 + A)$$

$$Q = 200 (10 [0.5]^2 + 0.5)$$

$$Q = 600 \text{ cfm}$$

$$Q = V (10X^2 + A)$$

$$Q = 1 (10 [0.15]^2 + 0.05)$$

$$Q = 0.28 \text{ m}^3/\text{s}$$

The importance of locating the hood opening close to the hot polymer is indicated by the fact that the “X” dimension is raised to the second power in the above equation. Thus, if this dimension were doubled in the above example, the volumetric rate of air flow required would increase to 200 ( $10 \times 1^2 + 0.5$ ) = 2100 cfm/1.0 m<sup>3</sup>/s, a rise of 250%.

## Machining

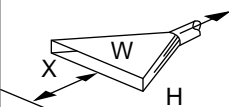
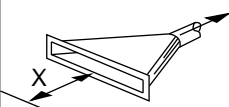
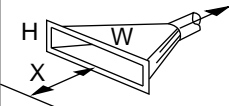
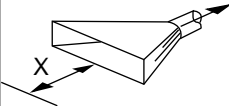
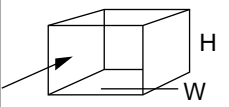
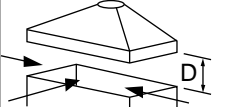
In grinding, sawing, and machining of *Teflon*® AF, measures should be taken to ensure that temperatures are maintained below 360°C (680°F). Generally, coolants are recommended in machining fluoropolymer resins to improve production rates and quality, and they can serve to control any tendency toward overheating.

## Respirable Dust

In any manufacturing or handling operation where dust from *Teflon*® AF may be created, the concentration of airborne dust should not be permitted to exceed the OSHA permissible exposure limits of 5 mg/m<sup>3</sup> respirable dust or 15 mg/m<sup>3</sup> total dust.

It is strongly recommended that tobacco not be used or carried in open packs around machining operations or where resin dust may be encountered, because smoking tobacco contaminated with fluoropolymer dust will result in inhalation of toxic thermal decomposition products.

Figure 1. Hood Design Data

Hood Types	Description	Aspect Ratio, H/W	Air Rate**
	Slot	0.2 or less	$Q = 3.7 WVX$
	Flanged slot*	0.2 or less	$Q = 2.8 WVX$
	Plain opening	0.2 or greater and round	$Q = V (10X^2 + A)$
	Flanged opening*	0.2 or greater and round	$Q = 0.75V (10X^2 + A)$
	Booth	To suit work	$Q = VA = VWH$
	Canopy	To suit work	$Q = 1.4 PDV$

\*Wherever possible, flanges should be provided to eliminate air flow from ineffective zones where no contaminant exists. Increasing the hood effectiveness in this manner will usually reduce air requirements by 25%. For most applications the flange width can be equal to the hood diameter or side but need not exceed 15 cm (6 in).

\*\*Nomenclature

V = Centerline velocity at X distance from face of hood, m/s (fpm) (use recommended capture velocities from **Table 1**)

X = Distance from source to face of hood, m (ft)

Q = Air volume, m<sup>3</sup>/s (cfm)

A = Area at face of hood, m<sup>2</sup> (sq ft)

P = Perimeter of work, lin m (lin ft)

D = Height above the work, m (ft)

H = Height of hood, m (ft)

W = Width of hood, m (ft)

**Table 1**  
**Capture Velocities Recommended in Various Work Situations**

<b>Dispersion of Contaminants into Air</b>	<b>Examples</b>	<b>Capture Velocity, m/s (fpm)</b>
Released with practically no velocity into quiet air.	Drying of fluoropolymer resins—granular, powder, cubes; evaporation of solvents, water, etc.	(0.25–0.50) 50–100
Released at low velocity into moderately still air.	Spray coating with solutions. Normal blending of fluoropolymer cubes or powders. Molding of fluoropolymer resins.	(0.50–1.0) 100–200
Active generation into zone of rapid air motion.	Melt extrusion of fluoropolymer resins. Injection and transfer molding of resins.	(1.0–2.5) 200–500
Released at high initial velocity into zone of very rapid air motion.	Grinding and machining of parts from fluoropolymer resins. High-speed mixing of fluoropolymer powders in turbulent mode.	(2.5–10.0) 500–2,000

In each category above, a range of capture velocities is shown.  
The proper choice of values depends on several factors:

**Lower End of Range**

1. Room air current minimal or favorable to capture
2. Contaminants of low toxicity
3. Intermittent, low production
4. Large hood—large air mass in motion

**Upper End of Range**

1. Disturbing room air currents
2. Contaminants of high toxicity
3. High production, heavy use
4. Small hood—local control only

## **Soldering and Melt Stripping**

The combined effects of temperature, quantity of resin, exposure time, and ventilation conditions during soldering and melt stripping are unlikely to produce conditions of toxicological significance. Any special practices that may be warranted will follow the rules applicable to any soldering work. For example, prolonged soldering in confined spaces where natural air circulation is restricted will require mechanical ventilation. The same is true for shop areas where a number of workers are engaged in soldering or melt stripping operations. Normal ventilation provided for worker comfort usually provides adequate safety for these operations. As an added measure during melt stripping and soldering, many shops use an exhaust duct at each work station.

## **Scrap Disposal**

Disposal of scrap *Teflon*® AF presents no special problem to the user. It is best to dispose of such scrap in a landfill dump without burning.

Small amounts of scrap, up to approximately 5 kg (10 lb) at a time, are often incinerated along with general plant refuse. The incinerator should have sufficient draft to exhaust all combustion products to the stack. Normal care should be taken to avoid breathing smoke and fumes from any fire. In addition, because many polymers produce acids in their combustion products (in the presence of moisture, decomposition products of fluoropolymers contain HF), the stack should be high enough to dilute the acid content of the exhaust gases to an acceptable level. HF causes strong eye and nose irritation before approaching systemically toxic levels. It is also capable of etching glass. In addition, vegetation is particularly sensitive to HF. Where desirable vegetation is present, do not burn scrap fluoropolymers in an open dump during periods of heavy humidity, fog, or smog.

In the reclamation of metals by melting of scrap, it is advisable first to remove any nonmetallic components in order to avoid generating more organic vapors than necessary. The furnace should have sufficient draft to exhaust all gases to the stack.

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